in the affected segments. The remaining 115 segments had normal filling curves and no significant coronary stenosis.

Conclusions: Quantitative CK allows objective detection of regional diastolic dysfunction in patients with CAD and no evidence of regional wall motion abnormality at rest.

1051-139 New Method for On-line Quantitative Analysis of Regional Wall Motion Using Color Kinesis

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Recently, Color Kinesis based on acoustic quantification has been clinically introduced as a new method for objective assessment of LV endocardial wall motion, but current system cannot allow us on-line analysis. In this study, we have newly developed automated segmental motion analysis (ASMA) method and attempted on-line quantitative assessment of LV regional wall motion in 10 normal subjects (N), 5 pts with myocardial infarction (MI), and 3 pts with dilated cardiomyopathy (DCM).

Methods: Parasternal short axis view was obtained for kinetic analysis. Gain controls were adjusted to optimize tracking of the endocardial boundary, and a region of interest surrounding the LV cavity was defined. The LV cross-sectional area was automatically divided into 4 equiangled wedge-shaped sectors. Color pixel counts within each sector were used to calculate regional fractional area changes (FAC). FAC in each sector was expressed as a percent of end-diastolic area, and frame-by-frame changes of FAC in each sector were displayed in real time as bar graph.

Results: In N, uniform FAC between segments were observed in real time. In short axis view of N, end-systolic FAC were 39 ± 12% in IVS, 38 ± 18% in anterolateral, 40 ± 14% in posterior and 48 ± 20% in inferior regions. In contrast, the value of FAC were obviously decreased in infarct-related regions in MI and globally decreased in DCM.

Conclusion: ASMA is a new reliable tool that provides on-line quantification of regional wall motion analysis.

1051-140 Tissue Harmonic Imaging Enables Improved Detection of Left Ventricular Endocardial Border Comparable and Complementary to Contrast Blood Pool Enhancement

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Purpose: Harmonic imaging is a new imaging modality utilizing a nonlinear acoustic response. Our study was designed to compare the information contained in fundamental frequency and 2nd harmonic images of human left ventricle (LV) obtained before and after the i.v. injection of ultrasonic contrast agent, Levovist.

Method: We studied 32 pts using standard apical LV views with 3 harmonic imaging echo systems (Acuson Sequoia, HP Sonos 5500, and ATL 3000). LV was visualized using optimized fundamental image (F), lower frequency (1.66–1.8 MHz transmit, H1) and higher frequency (2.1–2.5 MHz transmit, H2) 2nd harmonic. Quality of endocardial border delineation in 16 standard segments was scored in 0–2 scale by consensus of 2 experienced observers. Scores were averaged to produce an endocardial visualization index (EVI). EVI was also calculated after i.v. Levovist (400 mg/ml, total dose 2.5 g) in the harmonic mode (H + C).

Results: H1, H2 and H + C significantly improved endocardial border detection (ANOVA $P < 0.001$). H1 and H + C outcome was similar. In addition, harmonic modes improved intraobserver reproducibility of LV volume calculation.

	EVI total	EVI basal	EVI middle	EVI apical	# segm. optimal	# segm. subopt.	# segm. invisible
F	1.23 ± 0.39*	1.23 ± 0.79*	1.23 ± 0.81*	1.24 ± 0.65*	222*	187*	103*
H1	1.65 ± 0.40	1.67 ± 0.61	1.67 ± 0.61	1.58 ± 0.64	369	105	38
H2	1.54 ± 0.42	1.57 ± 0.73	1.62 ± 0.64	1.38 ± 0.75#	319#	101#	60#
H + C	1.71 ± 0.32	1.65 ± 0.65	1.73 ± 0.58	1.78 ± 0.47	341	76	31

* $p < 0.05$ vs H1, H2, H2C; # $p < 0.05$ vs H1, H + C

Conclusions: Harmonic LV imaging without contrast enhancement significantly improves the visualization of endocardial border, similarly to imaging with Levovist. Contrast additionally improves the visualization of apex but attenuation hampers the imaging of basal LV segments.

1051-141 Harmonic Versus Fundamental Echocardiographic Imaging for Endocardial Definition

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Harmonic imaging selectively amplifies nonlinear higher frequency reflections, which may improve beam focus and reduce clutter.

Objective: The purpose of this study was to compare harmonic and fundamental (standard imaging at the crystal frequency) echocardiography for endocardial definition.

Methods: The subjects were 51 technically difficult to image pts who underwent two-dimensional echo of the LV in 3 standard views (apical 4-and 2-chamber, and parasternal long axis). Harmonic imaging was performed with either Acuson-SequoiaTissue Harmonics, or ATL HDI 3000 Frequency Conversion Technology. Both harmonic and fundamental images were digitized and displayed in random order as cine loops side-by-side for simultaneous comparison by blinded experienced observers.

Results: Harmonic imaging was graded superior to fundamental imaging for endocardial definition (superior: harmonic = 71.1%, fundamental = 18.7%, similar = 10.2%; $p < 0.001$). Harmonic imaging afforded more consistent superiority over fundamental imaging for the apical 4-chamber view as compared with the apical 2-chamber and parasternal long axis views (harmonics superior: 4-chamber = 90.7%, 2-chamber = 82.2%, parasternal long axis = 76.3%). Additionally, harmonic imaging was superior to fundamental imaging for the apical segments (superior: harmonic = 86.9%, fundamental = 10.6%, similar = 2.5%; $p < 0.001$).

Conclusions: Harmonic imaging improves endocardial definition compared to fundamental imaging, particularly in the apical 4-chamber view.

1051-142 Why Does Tissue Harmonic Imaging Improve Image Quality: A Quantitative Examination Demonstrating Side-Lobe Suppression

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Harmonic imaging exploits the spontaneous generation of higher frequencies as ultrasound propagates to improve image quality, but the quantitative explanation of this improvement is unknown.

Hypothesis: Because harmonics are generated in a nonlinear relation to fundamental signal strength, we hypothesized that side lobe harmonics would be much lower in relation to central beam strength resulting in less clutter in the cavity, improved wall definition, and a higher signal-to-noise ratio (SNR) between cavity and wall.

Methods: Paired examinations (fundamental vs harmonic) were performed on 2 walls and the cavity from each of three windows in systole and diastole for 5 patients. From 100-pixel regions of interest (ROI, total 180) mean intensity and standard deviations were calculated. Additionally an unpaired t-statistic was calculated between wall and cavity to assess overall image SNR.

Results: Values are for pixel intensity (0–255 scale) except SNR:

Variable	Fundamental	Harmonic	p
Wall intensity	35.8	39.0	0.03
Wall std. dev.	9.8	13.0	0.03
Cavity intensity	8.9	3.5	$< 10^{-8}$
Cavity std. dev.	6.0	4.1	< 0.0001
SNR	1.75	2.08	< 0.0001

Conclusions: 1) Harmonic imaging results in a darker cavity and brighter walls, improving contrast; 2) the most prominent cause is a dramatically cleaner cavity, consistent with significant side lobe suppression.

1052 Effects of Hypertension on the Arterial Wall

Monday, March 30, 1998, Noon–2:00 p.m.
Georgia World Congress Center, West Exhibit Hall Level
Presentation Hour: 1:00 p.m.–2:00 p.m.

1052-47 Effect of Ca^{++} Antagonists and ACE Inhibitors on the Elastic Properties of the Aorta in Essential Hypertension: Different Mechanisms of Action

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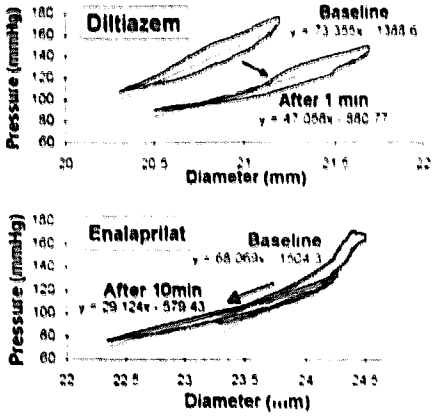
Background: Although Ca^{++} antagonists and ACE inhibitors are widely used

in the treatment of hypertension, their effect on the elastic properties of the aorta and the mechanisms involved have not been defined.

Methods: Serial pressure-diameter loops were obtained in 20 hypertensive pts before and for 20 min after i.v. infusion of diltiazem (DL, 10 pts, 0.15 mg/kg over 2 min) or enalaprilat (EN, 10 pts, 1.25 mg over 5 min). Aortic diameter was measured by an ultrasonic intravascular catheter developed in our institution (Circulation 1995; 92: 2210–9). Ao pressure was measured simultaneously by a Millar catheter.

Results: Aortic distensibility increased after both DL and EN (from 1.3 ± 0.3 to 1.9 ± 0.5 and from 1.2 ± 0.3 to 2 ± 0.4 10^{-6} cm^2 $dyne^{-1}$, respectively, $p < 0.001$ for both). While improvement in aortic elasticity after DL was active, (loop shifting toward the left, left fig) due to alteration of the intrinsic aortic elastic properties, the one after EN was passive (loop sliding along the same hypothetical line of elasticity, right fig) due to blood pressure reduction alone.



Conclusion: Both DL and EN improve aortic elastic properties in hypertensive patients, however, different mechanisms of action are involved.

1052-48 Plasma Levels of Soluble E-Selectin in Patients With Mild to Moderate Hypertension Treated by a Calcium Antagonist or a I_1-Imidazoline Agonist

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Background: Not all antihypertensive treatments have the predicted beneficial effect on atherosclerotic vascular disease and this may be due to their failure to regulate endothelial cell dysfunction associated to hypertension. E-Selectin, a surface molecule expressed on activated endothelial cells, is implicated in the very early stages of atherosclerosis by mediating adhesion of leukocytes to endothelium. The aim of this study was to evaluate the effect of a calcium antagonist isradipine SRO and a I_1-imidazoline agonist moxonidine on plasma levels of soluble E-Selectin (sE-Sel) proposed as marker of early endothelial dysfunction.

Methods: Fifty two patients (pts) with mild to moderate hypertension, divided in two groups (group A: 24 pts treated by isradipine SRO, 4 mg daily and group B: 28 pts treated by moxonidine, 0.4 mg daily) were evaluated for heparine plasma levels of sE-Sel, measured by ELISA, before and after four months of therapy and compared to 31 age and sex matched controls. Before treatment, groups A and B did not differ in any of systolic and diastolic blood pressure (SBP and DBP, respectively), age, body mass index, left ventricular mass index or total peripheral resistances.

Results: The results are summarized in the following table:

Parameter	Controls	Group A	Group B
sE-Sel (ng/mL) before	23.6 ± 1.8	37.9 ± 2.9*	36.2 ± 2.8*
after		32.5 ± 2.1*▲●	37.1 ± 3*▲●
%Δ		-11.9 ± 4.1	2.5 ± 1.5
SBP (mmHg) before	114.2 ± 1.3	157.6 ± 3.2*	161.4 ± 3.9*
after		123.6 ± 3.9▲	133.1 ± 2.1*▲
%Δ		-21.4 ± 2.7	-17.1 ± 1.8
DBP (mmHg) before	80.1 ± 2.3	102 ± 1.3*	10..1 ± 1.1*
after		80.2 ± 2.1▲	86.4 ± 0.7▲
%Δ		-21.3 ± 2	-14.7 ± 0.9

1) %Δ: percent differences, 2) significant differences ($p < 0.05$) in comparison to corresponding values: a) of controls (*), b) before the respective treatment (▲) and c) after the comparable treatment (●)

In group A, significant negative correlation was found between DBP before treatment and %Δ of sE-Sel plasma levels ($r = -0.7$, $p = 0.03$). No other significant correlations were found.

Conclusions: It is suggested that, in mild to moderate hypertension, treatment with isradipine SRO may be more effective than treatment with moxonidine in regulating endothelial cell function at least by decreasing plasma levels of sE-Sel proposed as marker of endothelial dysfunction and this is not related to the effectiveness of antihypertensive treatment in decreasing SBP or DBP. In addition, isradipine SRO treatment seems to be less effective in decreasing plasma levels of sE-Sel for pts with high DBP than for those with low DBP before treatment.

1052-49 Aortic Atheroma in Hypertensive Patient: May Ambulatory Blood Pressure Data Predict Severity?

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Hypertension (HT) is a determinant factor of atheroma development. The aim of this study was to assess if there was a relationship between data of 24 hours ambulatory blood pressure (ABP) and severity of thoracic aortic atheroma in hypertensive patients. We studied 65 patients (44 men, 21 women), mean aged 66.2 ± 11.4 years, with HT and past cerebral vascular event. ABP recordings were performed every 15 minutes during the day (D), and 30 minutes during the night (N). Atheroma was evaluated by transesophageal echocardiography. We used a scoring index (SI) including the sum of plaque thickness (PT: <2 mm: 2 to 4.9 mm: >5 mm) and diffusion: number of involved aortic segments (ascending, horizontal, descending). Persistent HT was assessed on D and N means ABP, according to Staessen's meta-analysis. Dippers were patients who decreased systolic N > 10 and diastolic N > 5 percents. Monovariate results: there was no relation between PT or SI and sex, obesity, diabetes mellitus. Age was related to PT ($p = 0.005$) and SI ($p = 0.022$). PT was more severe in persistent HT ($p = 0.022$). Multivariate regression including age and means ABP showed an increase of SI and PT with age ($b = +0.06$ $p = 0.03$, $b = +0.04$ $p = 0.01$), diastolic D ABP ($b = +0.32$ $p = 0.0008$, $b = +0.18$ $p = 0.0018$), systolic N ABP ($b = +0.17$ $p = 0.0008$, $b = +0.09$ $p = 0.0018$), and with decrease of systolic D ABP ($b = 0.21$ $p = 0.0005$, $b = 0.11$ $p = 0.002$) and diastolic N ABP ($b = 0.29$ $p = 0.0008$, $b = 0.16$ $p = 0.0009$). Multivariate correlations SI: $r = 0.49$, $p = 0.0065$ and PT: $r = 0.49$ $p = 0.005$. Adjusted means dippers/non dippers for SI: 0.27 ± 0.45/2.52 ± 0.27, $p = 0.0006$ and for PT: 0.29 ± 0.23/1.45 ± 0.14, $p = 0.0005$. In conclusion, ABP may be a marker of aortic atheroma severity in patients with hypertension.

1052-50 Arterial Compliance and Hypertensive Left Ventricular Geometry

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Background: We have previously reported that the ratio between stroke volume (SV, M-mode echocardiography, Teichholz') and pulse pressure (PP) in adults is a measure of arterial compliance that is related directly to body weight and negatively to age and heart rate, by a multiple linear equation, which has been re-computed using a new validated method (z-derived) for determination of M-mode volumes.

Methods: The ratio of observed-to-predicted SV/PP (%ΔSV/PP) was calculated in our reference population of 393 normal adults and the normal 95% confidence interval was determined (71.6–139.3%). %ΔSV/PP was computed in 491 hypertensive patients (HPTS, 161 women, 228 overweight; 53 ± 10) and 537 normal controls (NOR, 224 women, 149 overweight; 46 ± 12 years, $p < 0.0001$).

Results: Low %ΔSV/PP (<71.6%) was present in 39 NOR (7.3%) and 204 HPTS (41.5%, $p < 0.0001$). In both NOR (—) and HPTS (), LV mass (LVM) was related to systolic pressure ($r = 0.37$ and 0.22) and, weakly,